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PROBLEMS.

39. **Proposed by O. W. ANTHONY, M. Sc., Professor of Mathematics in New Windsor College, New Windsor, Maryland.**

A man is at the center of a circular desert; he travels at a given rate but in a *perfectly* random manner. What is the probability that he will be off the desert in a given time?

40. **Proposed by HENRY HEATON, M. Sc., Atlantic, Iowa.**

If every point of an ellipse be joined with every other point, what is the average length of the chords thus drawn?

41. **Proposed by F. P. MATZ, D. Sc., Ph. D., Professor of Mathematics and Astronomy in Irving College, Mechanicsburg, Pennsylvania.**

A line is drawn at random across the chord and *given* arc of a circular segment. Find the mean area of the *divisions*.

MISCELLANEOUS.

Conducted by J. M. COLAW, Monterey, Va. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

35. **Proposed by WILLIAM SYMMONDS, A. M., Professor of Mathematics and Astronomy in Pacific College, Santa Rosa, California; P. O., Sebastopol, California.**

To an observer whose latitude is 40 degrees north, what is the sidereal time when Fomalhout and Antares have the same altitude: taking the Right Ascension and Declination of the former to be 22 hours, 52 minutes, —30 degrees, 12 minutes; of the latter 16 hours, 23 minutes, —26 degrees, 12 minutes?

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Applied Science, Texarkana College, Texarkana, Arkansas-Texas.

Let λ=latitude of observer, α, δ, α_1, δ_1 the Right Ascension and Declination of Fomalhout and Antares, respectively, β=altitude, h, h_1 the hour angles.

$\therefore \sin\beta=\sin\lambda\sin\delta+\cos\lambda\cos\delta\cos h=\sin\lambda\sin\delta_1+\cos\lambda\cos\delta_1\cos h_1$.

Also $h+\alpha=h_1+\alpha_1$.

But $\lambda=40^\circ$, $\alpha=343^\circ$, $\alpha_1=245^\circ\ 45'$, $\delta=-30^\circ\ 12'$, $\delta_1=-26^\circ\ 12'$.

$\therefore 66207\cos h-68734\cos h_1=3954$............(1).

$h_1-h=\alpha-\alpha_1=97^\circ\ 15'$, $\cos(h_1-h)=.12620$............(2).

Let $\cos h=x$, $\cos h_1=y$.

$\therefore$ from (2) $y=.1262x\pm\sqrt{.98407-.98407x^2}$. This in (1) gives $57532.7692x \mp 68184.81534\sqrt{1-x^2}=3954$.

$\therefore x^2-.05716x=.58216$, $\therefore x=.79211$ or $-.73495$.

.·. $h=37^\circ\ 37'$ or $137^\circ\ 18'12''$. $h=2$ hours, 30 minutes, 28 seconds, or 9 hours, 9 minutes, 12.8 seconds.

.·. sidereal time$=1$ hour, 22 minutes, 28 seconds, or 8 hours, 1 minute, 12.8 seconds.

36. Proposed by J. K. ELLWOOD, A. M., Principal of the Colfax School, Pittsburg, Pennsylvania.

"What is the length of a chord cutting off one-fifth of the area of a circle whose diameter is 10 feet?"

I. Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Mathematics and Applied Science, Texarkana College, Texarkana, Arkansas-Texas.

Let the chord subtend an angle$=2\theta$, $a=$radius of circle. Then the length of the chord$=2a\sin\theta$.

.·. $a^2(\theta-\sin\theta\cos\theta)=\frac{1}{5}\pi a^2$.

.·. $\theta-\sin\theta\cos\theta=\frac{1}{5}\pi$, .·. $\theta=60^\circ 32'$ nearly.

.·. chord$=2a\sin\theta=10\sin\theta=8.7064$ feet.

II. Solution by BENJ. F. YANNEY, A. M., Professor of Mathematics, Mount Union College, Alliance, Ohio, and Prof. P. S. BERG, Larimore, North Dakota.

Let $\theta=$the angle at the center, subtended by the required chord. Then $10\sin\theta=$the length of the required chord. Now $\frac{2\theta}{360}\pi 25$, the area of the sector, $-5\sin\theta\sqrt{(25-25\sin^2\theta)}$, the area of the triangle, $=5\pi$, the given area of the segment. Whence, by reduction, $\frac{\theta}{180}\pi-\sin\theta\cos\theta=\frac{\pi}{5}$.

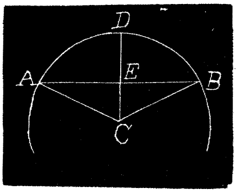
.·. $\frac{\theta}{90}\pi-2\sin\theta\cos\theta=\frac{2}{5}\pi$. .·. $.0349065\theta-\sin 2\theta=1.256637$.

From which we readily find, by supposition, the value of θ; and from this, the value of $10\sin\theta$ to be 8.706, the length of the chord required.

III. Solution by A. H. BELL, Hillsboro, Illinois.

By Reversion of Series. Let the given diameter $=10=D$ and $1/5$ of circle$=a\pi r^2/d$, radius$=r$. To obtain the greatest convergency in the series, let ACB, the angle at the center$=2\theta$ and take the sector $ACD=r^2\theta/2$ and $r^2\sin\theta\cos\theta/2=ACE$.

Then $r^2(\theta-\sin\theta\cos\theta)/2=a\pi r^2/2d$ or arc$\theta=a\pi/d+\cos\theta\sqrt{(1-\cos^2\theta)}$ ....(1).



Make $\cos\theta=x$, and when expanded,

$$\theta=\frac{a\pi}{d}+x-\frac{x^3}{2}-\frac{x^5}{2.4}-\frac{3x^7}{2.4.6}-\frac{3.5x^9}{2.4.6.8},\ \text{etc.},\ldots\ldots\ldots\ldots(2).$$

By trigonometry or calculus, we have,

$$\text{arc}\theta=\frac{\pi}{2}-x-\frac{x^3}{2.3}-\frac{3x^5}{2.4.5}-\frac{3.5x^7}{2.4.6.7}-\frac{3.5.7x^9}{2.4.6.8.9},\ \text{etc.},\ldots\ldots(3).$$